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GEOLOGY

OF THE

Disseminated Lead Deposits

OF

St Francois and Washington Counties

BY

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LAMOTTE FORMATION

This is the oldest recognized Cambrian formation in the state It overlies unconformably the rocks of the Laurentian and Huronian wherever they may occur However, it is interesting to note that the identified Huronian at Pilot Knob is not overlain with any of the younger formations and that all drill holes which have penetrated the Archean granite or porphyry have failed to show recognizable Huronian strata This evidence leads one to surmise that the Huronian was either practically all removed prior to the incursion of the Cambrian Sea, or that it never occurred over a greater part of the region Upon this point we may always be in doubt There is also some doubt as to whether the conglomerate at Pilot Knob is of sedimentary origin, it being believed by some to be a breccia The extreme irregularity of the pre-Cambrian floor upon which the Lamotte sandstone rests, although partly attributable to subsequent deformation as pointed out above, is also the result of pre Cambrian erosion

The Lamotte formation was spread out over the irregular surface of igneous rocks filling up many of the lesser depressions This is the only part of the state in which this sandstone is known to outcrop Here it is the surface formation over an area of approximately 200 square miles, only a small portion of which is in the area included within this report The boundaries of this sandstone have been mapped with considerable detail over much of the area, for use in the general geological map, Plate XL From this the reader will see that this sandstone is wrapped about the St Francois mountains, the greatest area being about the Jonca granite hills

This formation consists of a conglomerate at the base, above which sandstone and conglomerate alternate for a considerable distance, finally grading into a coarse and then into a medium to a fine grained sandstone Near the top it consists of alternating beds of sandstone and dolomite passing into the Bonneterre dolomite formation without definite line of contact

The conglomerate occurs irregularly at and near the base, being present in some places and not in others It is thirty feet thick in some places and in others it consists of only a thin layer In the conglomerate horizon beds of coarse arkose alternate with others containing pebbles and boulders of granite and rhyolite The pebbles and boulders are smooth and well rounded Beds of con-

glomerate alternate with arkose near the outcrops of igneous rock while above arkose beds alternate with sandstone, finally passing into a coarse and fine grained sandstone with fairly well defined bedding planes This condition is well exhibited around the flanks of Simms mountain, especially in Secs 22 and 27, T 36, R. 4 E Along what is known as Dry Fork the conglomerate occurs in isolate patches plastered onto the rhyolite hillsides far up the ravine On the general geologic map no attempt has been made to locate these patches, the areas being too small to distinguish from the Archean The beds of gravel and boulders extending some distance from the shore line and interbedded with sandstone are typical intraformational conglomerates such as have been described as occurring near the base of the Postdam sandstone of the Baraboo Bluffs in Wisconsin

The thickest exposure of sandstone on the Bonne Terre sheet is in Secs 22 and 27, T 36N R 4E Here the sandstone is 150 feet thick. In Secs 8 and 9, T 35N R 3E 140 feet of sandstone is exposed In determining these thicknesses the altitude of the outcrops is taken as a basis This is not the maximum thickness of the sandstone, which in the deeper parts of the basins must be over 250 feet thick On the Farmington quadrangle one mile east of Sprott the Lamotte sandstone occurs between elevations of 1050 feet and 845 feet, which, provided the beds extend horizontally from the crystalline core, will give the formation a thickness of 205 feet

The transitional zone lying between the Lamotte sandstone and the Bonneterre dolomite is represented by alternating beds of dolomite and sandstone extending in places through a thickness of forty or fifty feet The beds of sandstone at this horizon are usually chloritic and frequently contain thin laminae of shale.

This alternation of dolomite and sandstone is best exhibited on the Bonne Terre sheet near the old Swallow mines in the S W ¼ of Sec 11 T 35N, R 3E At this place the ore occurs in a 6-8 foot bed of arenaceous dolomite which is overlain with sixteen or more feet of sandstone This same alternation of limestone and sandstone beds occurs about one mile east of Farmington and also in Sec 9, T 35N, R 7E The same condition has been found to exist on the Hoffman tract near Leadwood where sandstone beds have been drilled through into lead-bearing dolomite Drilling on other tracts has shown this to be very generally the condition throughout the district.

Drill holes that have passed through the overlying Bonneterre

dolomite into the sand have in some places encountered a very much indurated quartzitic phase which acts as an almost impervious horizon shutting off the water in the underlying porous sandstone In the vicinity of Leadwood a thickness of 30 to 40 feet of dark gray sandstone occurs beneath the Bonneterre formation, while in the valley through which Hayden creek flows drilling has revealed the presence of a well defined conglomerate at the base of the sandstone This conglomerate consists of fragments of granite and rhyolite embedded in a shaly sandstone matrix

A hole drilled at the office of the St Joseph Lead Company at Bonne Terre passed through 239 feet of sandstone into a rhyolite conglomerate and then into rhyolite Near Flat River the Doe Run Lead Company drilled eighty feet into the sandstone A hole was drilled 95 feet into the sandstone at Shaft No 1 of the Federal Lead Company The following are detailed descriptions of the drill cores obtained from the holes which penetrated the sand on the properties of the St Joseph Lead Company and the Federal Lead Company

LOG OF DRILL HOLE LOCATED 70 FEET NORTHEAST OF ST JOSEPH LEAD COMPANY S OFFICE AND 190 FEET NORTHWEST OF NO 1 SHAFT

From Ft	From In	To Ft	To In	
0		17	6	Sleeve
				BONNETERRE FORMATION
17	6	32		Yellow limestone.
32		87		Light colored limestone with occasional patches and seams of yellow and buff limestone
87		97		Gray limestone
97		99		Dark gray limestone
99		114	6	Dark gray porous limestone with about 6 inches of buff colored limestone at 100
114	6	123		Buff and light colored limestone
123		133		Gray limestone
133		158		Gray mostly porous limestone
158		169		Firm gray limestone
169		179		Firm light gray limestone
179		215		Gray limestone A thin, diagonal seam of calcite and pyrite at 207 and 212' and a thin sheet of pyrite at 214
215		217		A light gray brecciated limestone with waves of dark shale and pyrite
217		219		Light gray limestone with about 4 inches scattering pyrite
219		227		Light gray limestone with a vertical seam of calcite and leaves of dark shale at 220'
227		231		Light colored brecciated limestone
231		240		Light gray limestone and occasional waves of dark shale with a small bunch of calcite at 232'
240		257		Light gray limestone with a vertical seam of calcite At 248 and 249 a thick vertical seam of calcite
257		267		Light gray limestone with an open, vertical seam at 259 where water was lost
267		303		Light gray limestone with occasional waves of dark shale below 287 (about 3 shale at 294)
303		327		Light gray limestone and thin layers or waves of dark shale with scattering chlorite from 340' to 342'
327		330		Light gray limestone and thin layers or waves of dark shale with scattering chlorite granules from 340' to 342'

From Ft	From In.	To Ft	To In.	
35		3[illegible]		Light gray limestone with occasional layers of shale well mixed with chlorite at 368 369 3[illegible]1 3[illegible]5 and from 3[illegible]5 to 3[illegible]
3[illegible]		387		Mostly chlorite with layers of light gray limestone and some thin layers of shale.
38		392		Chlorite with layers of gray sandy limestone.
				LAMOTTE SANDSTONE.
392		412		Gray yellow and brown sandstone (at 393 and 408 white)
412		415	6	Gray very sandy rock with traces of shale
415	6	421		Light colored sandstone (some white and brown at 418 and at 421 yellow with thin layers of shale)
421		42[illegible]		Gray sandy rock with about 3 limestone and traces of shale
423		4[illegible]4		Light colored limestone
4[illegible]4	7	4[illegible]6		Light colored sandy limestone
426		44		Mostly yellow white and brown coarse grained sandstone (or more ground up probably owing to the extreme softness of the formation
446		45		Fine grained light colored sandstone with thin layers or waves of dark shale (coarse grained light colored sandstone at 45 and at 5
45		462		Fine grained light colored sandstone with layers or waves of dark shale
462		4[illegible]2	6	Coarse grained gray sandstone with layers and waves of dark shale (Occasionally quite shaly after about 450)
4[illegible]2	6	485		Light colored sandstone and then soft coarse grained gray sandstone to 485 of which only a few pieces of core were obtained it apparently being too soft to form cores
485		502	6	Yellow and buff colored sandstone
502	6	505	3	Light colored sandstone with shale layers
505	3	50		White sandstone
50		531		Light colored sandstone with occasional dark layers (At 514 a heavy layer of shale and a little shale inside of core at 524)
531		542		Light colored sandstone with about one inch shale at 533
542		544		Mostly shale
544		581		Light colored sandstone with a bunch of shale and iron pyrites inside of core at 546 and 555 a thin layer of shale at 549' and 553 shale at 562' and 563 and a thin layer of shale at 567' 569' 573 and 5[illegible]5 two thin layers of black shale at 576 and thin layers of shale at 579' and 580 (After 558 the sandstone was occasionally of a very coarse pebbly character)
58[illegible]		611		Light colored sandstone with traces of shale at 605 and 610' and occasional layers of a very coarse pebbly nature from 598 to 605
611		623		Light colored sandstone with a heavy layer of shale at 619
623		631		Gray sandstone with a layer resembling porphyry at 624
631		635		A grayish rock carrying traces of porphyry shale seams and scattering pyrite
635		638		Porphyry and shale.
638		652		Porphyry and then changing into red granite
652		652		Red granite This granite was too hard to drill even with a 300 Feed

SUMMARY

Depth From Ft	Depth From In.	Depth To Ft	Depth To In.	Thickness. Ft	Thickness. In	Formation
0		1[illegible]	6	1[illegible]	6	Residual Clay
1[illegible]	6	393		3 4	6	Bonneterre formation.
393		631		239		Lamotte sandstone
631		652		21		Rhyolite (porphyry)
652		662		10		Granite

The record of the lead cut in this drill hole has been omitted the intention being to simply show the thickness of the Bonneterre and Lamotte formations

LOG OF HOLE DRILLED AT THE BOTTOM OF SHAFT NO 1 FEDERAL LEAD CO

From Ft	To Ft	
0	40	Dolomite (Bonneterre formation)
40	58	Medium grained sandstone (Lamotte formation)
58	71	Fine grained gray sandstone Some streaks coarser than others
71	0	Hard fine grained gray sandstone Few irregular shale leaves near base. At about 95 color changes abruptly to yellow and grain becomes coarser
9[illegible]	108	Hard but coarse white sandstone
108	1 1	One foot of fragments much ground up White and yellow coarse grained sandston
1?1	1 4	Coarse grained yellow sandstone hard [illegible]
1?4	126	Very coarse grained dark brown iron stained [illegible]
126	130	Fine grained to shaly yellow sandston Core [illegible]
130	135	Very fine grained hard white sandstone

The sandstone has a porosity of about 12 to 15 per cent and as a rule the pores are filled with water which in places is under hydrostatic pressure sufficient to cause it to flow upwards into the overlying limestone, sometimes even to the surface Prior to the opening of the mines of the Central and Doe Run Lead companies by which the water level has been lowered certain holes drilled into the sandstone along Flat River produced flowing wells North of Bonne Terre and elsewhere in this district the same results have been obtained In Madison county, where the same relations obtain between the Lamotte sandstone and the overlying formations flowing wells are sometimes encountered in prospect drill holes A water pressure of 80 to 95 pounds per square inch is not infrequently met with in underground drill holes that have penetrated the sandstone or channels connected with the sandstone Such pressures have been recorded in Federal No 2, Doe Run No 4 St Joseph No 11, and other mines It is thought that this pressure is not due entirely to the hydrostatic condition of the water within the Lamotte sandstone but that it is in part the result of pressure from water filling channels and branch channels within the Bonneterre dolomite which extend to the sandstone

However, the prevalent idea that the Lamotte sandstone is an enormous reservoir of water has led the operators of the district to avoid breaking into it, the practice being to leave several feet of limestone above what is supposed to be the top of the sandstone to act as an impervious cover It is also the practice to leave several feet of rock between the water channels in the Bonneterre dolomite and the mine workings

The sandstone, near the top often contains disseminated galena and has in a number of instances been mined with the limestone This is true at Desloge Mine No 4 St Joseph Mines No's 12 and 14, and at other mines In places the galena is known

to occur thinly disseminated through the Lamotte sandstone to a depth of at least forty feet below the contact with the Bonneterre formation In Madison county at the North American mine some of the richest lead has been obtained from the sandstone immediately underlying the Bonneterre formation Galena is also known to occur in the conglomerate at the base of the formation The discovery of workable deposits of ore within the Lamotte sandstone is not at all improbable in fact galena might be expected to occur especially in the shaly portions of this formation

The upper surface of the Lamotte sandstone reflects to a considerable degree, the irregularities of the underlying igneous rocks It rises and falls, often in gentle undulations from one place to another In places it presents abrupt escarpments of from twenty to forty feet and even more as shown by the drill records These abrupt changes in the level of the upper surface of the sandstone are in the main the result of faulting, while the undulations are to be attributed to the uneven floor upon which the sandstone was deposited

It is interesting to note that in the vicinity of Doe Run and Iron Mountain which towns are south of this district records of drill holes show at least two sandstone horizons separated by fairly well defined dolomite beds A typical drill record shows 209 feet of yellow and gray dolomite 38 feet of gray and yellow sandstone 37 feet of dolomite and 36 feet of sandstone and granite conglomerate * With this condition existing less than ten miles from Flat River, it might be expected that similar dolomite horizons would be encountered beneath what is at present recognized as the upper surface of the Lamotte sandstone On the other hand the upper sandstone horizon shown by drill holes in the vicinity of Doe Run and Iron Mountain may be the equivalent of some of the lower beds of Bonneterre limestone of the Flat River area Of this we have no evidence, and the actual succession can only be determined by drilling to the underlying crystallines

The sea in which the Lamotte sandstone was laid down did not cover the entire surface of the land, as shown by numerous localities in which the overlying Bonneterre limestone rests directly upon the igenous rocks Its distribution was very general but during the period of its deposition the pre-Cambrian hills still rose above the sea, contributing the detritus of which the sandstone is composed

*For additional sections illustrating this condition, reference should be made to the Iron Mountain sheet report contained in Vol IX of the reports of this Bureau published in 1894

Very little is known of the fauna of the Lamotte sandstone In some of the transitional beds between the Bonneterre and this formation shells of Lingula and Lingulepis shells have been observed some of the chloritic beds being rich in these fossils A number of the phosphatic brachiopod shells were sent to Dr Charles D Walcott, who identified them as *Dicellomus* politus Hall which has a wide geographic range and occurs in both Middle and Upper Cambrian

It would have been very interesting to have prepared a map showing the elevation of the top of the Lamotte sandstone throughout the district but upon investigating the records of drill holes I discovered that many of them are so unreliable in their location of the sandstone level that any such map would be of very little service Hundreds of drill holes reported to have bottomed in La motte sandstone only reached the transitional beds

As a whole the Lamotte sandstone lies in the form of a pitch ing trough hemmed in to the northeast and southwest by masses of igenous rocks, abutting against dolomites and shales which have been lowered by faulting to the northwest, and coming nearly to the surface to the southeast These conditions are clearly shown in the accompanying map and cross sections Plates XL and XLI

Within this basin there are occasional ridges and other minor elevations of the sandstone the principal one being known as the Farmington anticline This ridge practically separates the trough into two forks In one the mines at Bonne Terre are located and in the other the Flat River Mines In other words a ridge of sand stone separates the ore horizon of the St Joseph Lead Company s mines at Bonne Terre from the ore horizon of the mines located south of Big River This ridge of sandstone is buried beneath the Bonneterre dolomite which gradually diminishes in thickness toward the east and increases in thickness toward the west The ridge appears to flatten out and disappears about three miles north west of Desloge

BONNETERRE FORMATION

The Lamotte sandstone is overlain with the Bonneterre formation which has a normal thickness of approximately 363 feet of dolomite, arenaceous, chloritic and argillaceous in the lower portion and slightly argillaceous near the top The Bonneterre for-

*The beds here called dolomite are magnesian limestone in which the percentages of magnesium and calcium are variable However they have all the usual characteristics of dolomite and are therefore called by this name in the present report

mation varies considerably in thickness since it overlaps the Lamotte sandstone and over-rides its billowy surface. The greatest thickness of which I have a record is for a drill hole near Delassus which passes through 448 feet of dolomite before penetrating the sandstone. Other records in the neighborhood of this hole show thicknesses of 440 and 435 feet. Southwest of Elvins in Sec 22, T. 36, R 4E, the thickness varies somewhat the maximum recorded being 355 feet In Sec. 12, T 36 R 5E the thickness varies from 396 to 406 feet West of Irondale a maximum thickness of 310 feet has been recorded On the land grant, U S Survey 3063, north of Farmington Junction there are several holes which indicate a thickness of about 380 feet In the vicinity of Bonneterre this dolomite is about 400 to 440 feet in thickness as shown by numerous drill holes West of the city of Bonne Terre on Secs 2 10 and 11, T 27 R 4E drill holes show a thickness of Bonneterre dolomite ranging from 372 to 433 feet the greatest thickness being in Sec 10 In the Leadwood area this dolomite is 360 to 420 feet in thickness as near as can be estimated from the available records

The variations in the thickness of this as well as the other formations, can best be understood by reference to the accompanying cross sections which have been drawn to a uniform scale using the records of drill holes, chiefly as a basis The variations in the thickness of this formation, as shown in these sections may be due in part to imperfections in the drill records The driller does not always recognize the top of the Bonneterre and he also frequently stops drilling in dolomitic or chloritic sandstone, which may lie forty feet or more above the bottom of the Bonneterre However, they are as nearly correct as can be obtained from the available data

As stated above there is no sharp line of contact between the Bonneterre formation and the underlying Lamotte sandstone. The Bonneterre usually contains near the base, beds of sandstone while the Lamotte sandstone contains beds of dolomite Thus through alternating beds of dolomite and sandstone the Lamotte grades into the overlying Bonneterre Some of the lower beds of limestone have a very conglomeritic appearance which combined with the often wavy and irregular bedding suggests the possibility of at least local unconformity Such irregular bedding is illustrated in the accompanying figures This is not referred to as being especially unusual, for similar phenomena have been observed in other Cambrian formations of this region, in places where there

was an additional evidence of unconformity It is suggested that these irregularities may be due to movements of the oceanic waters movements within the formation prior to its consolidation, or the result of settling occasioned by solution and consolidation of the sediments

The lower fifty to one hundred feet of the Bonneterre formation is marked by the presence of beds of arenaceous dolomite, thin beds of shale beds of chloritic dolomite and beds of chloritic arenaceous dolomite. The dolomite may have a dark gray color from the presence of bituminous matter or it may be light gray or even buff In some places it has a green color due to an abundance of chlorite which in some places is reported to be present continuously through a section of a hundred feet The percentage of chlorite varies the beds being composed in some places, almost entirely of this mineral while in other places the dolomite contains a mere sprinkling of chlorite granules The arenaceous beds usually have a buff or yellowish color frequently specked with granules of chlorite The shale is either a green, gray or brownish black and may be soft or hard The beds are seldom more than eight inches in thickness and usually thin and thicken as they are followed laterally A single bed frequently splits into two thin beds which may come together at another point The shale sometimes occurs in thin leaves separating thin beds of limestone

The black shale often has a spotted appearance due to lenticular or irregular inclusions of dolomite These inclusions are usually small, varying from the size of a grain of sand up to several inches in diameter

Bluish black, and green clays occur filling irregular cavities in the limestone, sometimes two or more feet in diameter They occur, likewise, along many of the fault planes and occasionally occupy some of the space between the walls of channels which have formed as a result of weathering A soft, sticky, red clay also occurs in some of the channels and along adjacent bedding planes Most of this clay is supposed to have been washed in from near the surface

In a few places the lower 20 to 30 feet of this formation is mainly shale, with thin interstratified beds of dolomite As a rule, however, this horizon consists of dolomite interstratified with thin beds of shale and gray dolomitic sandstone

Although galena occurs throughout the entire thickness of this formation, the principal deposits of disseminated ore occur in the lower portion, as described in a subsequent chapter

Pyrite, chalcopyrite and calcite are of frequent occurrence throughout the formation

The lower horizon is fractured faulted and broken and the bedding planes are well defined Frequently the beds are sharply inclined and local flexures are of common occurrence The dolomite is often porous and as a rule, it is thoroughly crystalline There is evidence that the rock has been completely re crystallized since being laid down The rocks at this level are usually saturated with water which rises along joint and fault planes from the underlying sandstone or flows in along channels from the surface

In general the lower horizon of the Bonneterre formation is a complex of shale sandstone and dolomite—chloritic, pyritiferous and galeniferous—in places fractured and faulted—through which there is an abundant circulation of ground water This horizon passes upwards into dolomite with little or no sandstone and fewer beds of shale The base of this formation is placed at the top of soft yellowish, reddish, or almost white non-calcareous sandstone From this it will be understood that the transitional beds between the Lamotte and Bonneterre formations have been included within the latter

The characteristics of the lower part of the Bonneterre are best exhibited in the mine workings, there being very few exposures of the lower Bonneterre in the region which has been under examination, altho the entire thickness outcrops upon the Bonne Terre and Farmington quadrangles Wherever this horizon is exposed at the surface chiefly in close proximity to the St Francois mountains the characteristics above enumerated are always in evidence

Of the upper two hundred and fifty to three hundred feet about one hundred and fifty feet are exposed along Flat river above its confluence with Big river, the remainder being exposed to the east and southeast at various localities This portion of the Bonneterre formation consists mainly of dark and light gray dolomite the beds of which are occasionally separated with thin laminae of shale The dolomite is thoroughly crystalline and at many horizons contains large and small cavities which impart a hackly appearance to the rock This horizon is broken with numerous sets of joints some of which are filled with calcite Large cavities filled with bluish clay and open seams filled with red residual clay are common The rock adjacent to the open channels is frequently decomposed and has a white gray or buff color Near the surface occur caves and openings along the channels contain-

Outcrops of Bonneterre dolomite along Owl creek

ing crystal aggregates of galena Hundreds of abandoned shafts mark the localities where shallow mining was carried on during the early part of the 19th Century Some tracts of land are covered with these abandoned holes, giving the surface a pitted appearance

As a rule the uppermost bed of the Bonneterre is an argillaceous dolomite having a mottled appearance on the weathered surface due to the irregular laminae of shale which are so interwoven that upon weathering they leave the dolomite in small irregular lenses Calcite is common in this bed The mottling is observed mainly on the weathered surface Some fossils have also been observed This bed is overlain with several feet of blue shale belonging to the Davis formation Beneath the mottled bed occur a number of dolomite beds

The upper beds of the Bonneterre formation are exposed at many places in the Flat River and Bonne Terre areas but nowhere are they better or more typically exhibited than in the bluff along Davis creek, just west of Shaft No 4 of the Federal Lead Company

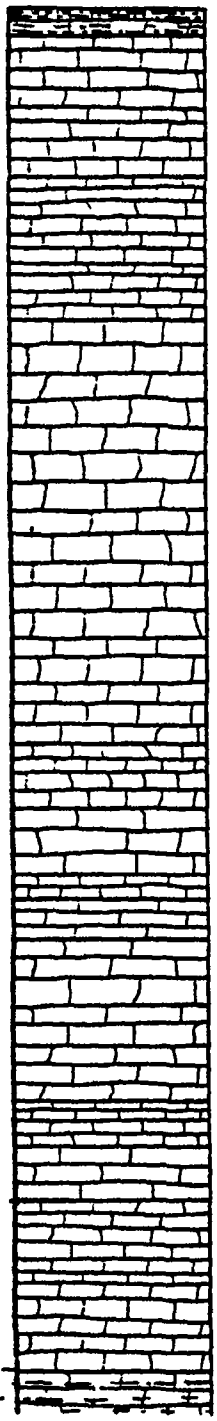
Wherever the upper beds of the Bonneterre are exposed along gentle slopes they usually have a craggy or honey combed appearance which can be best understood by an examination of the accompanying views, Plates VI and VII, which show different phases of weathering of these beds It will be observed that where the Bonneterre occurs in cliffs its appearance is not much different from that of some of the overlying formations The surface, however is much more hackly and cavernous

In several localities flecks of disseminated galena have been observed in the upper beds of the Bonneterre dolomite which outcrop at the surface Elsewhere in this volume it is pointed out that disseminated ore has been encountered in this formation at a depth of about fifty feet in the mines at Bonne Terre and elsewhere in drill holes Galena occurs at various horizons from the surface to the base of the formation, altho it has been segregated chiefly in the lower horizon of one hundred feet.

A close examination of the Bonneterre formation shows that the dolomite is, in the main, porous, containing small irregular cavities These cavities are more or less lined with or enclose calcite which effervesces freely in dilute hydrochloric acid Altho specimens from nearly all parts of the formation effervesce slightly with dilute hydrochloric acid, the upper half of the formation is distinctly the more calcareous as shown by the following section

Figure No 2

BONNETERRE FORMATION



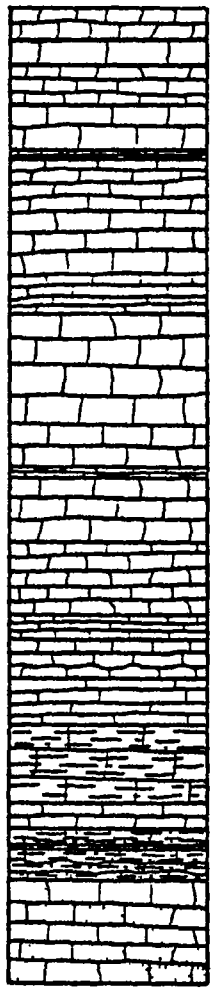
of the Bonneterre formation which is a detailed description of a drill core 1053 feet south and 3600 feet E of the N W corner of Sec 21, T 36N, R 5E

One experiences considerable difficulty in recognizing horizons at the surface by a comparison with specimens of cores from the same horizon obtained by drilling The outcrops at the surface are always more or less altered in appearance by weathering and through this process they acquire certain markings which are not recognizable in the drill core specimens For the purpose of recognizing in the surface outcrops the different beds of a formation like the Bonneterre, a detailed study of drill cores is not altogether satisfactory A study of the outcrop sections will prove much more helpful On the other hand if one wishes to recognize the various horizons of this formation as they are displayed in the drill cores, the study of an outcrop section will be equally unsatisfactory

COLUMNAR SECTION OF THE BONNE TERRE FORMATION FROM TOP TO BOTTOM

Ft	In	
3	4	Mottled streaked shaly dolomite Contains irregular masses of calcite (Description from surface outcrop)
22		Light buff to light gray dense hard dolomite. Fine flinty texture Very slightly calcareous
22		Brownish gray glistening finely porous crystalline dolomite. Slightly calcareous. Chiefly due to calcite crystals in cavities.
65		Very porous, yellowish to light brownish gray dolomite. Crystalline and shows glistening crystal faces. Slightly calcareous due to calcite in minute cavities.
10		Porous (less than last) crystalline very light gray grading to light buff Glistening crystal faces Fine compact texture. Slightly calcareous due to calcite in minute cavities.
10		Dark gray porous dolomite About as porous as last. Crystalline and shows glistening faces on fresh surface. Very slightly calcareous due to calcite in minute cavities.
4		Same as last but somewhat more porous Smaller crystals are evidently oriented together to give a broad reflection in places. Very slightly calcareous due to calcite in minute cavities.
6		Dark gray limestone similar to last Hard dense and glistening 3 per cent disseminated galena Very slightly calcareous due to calcite in minute cavities.
25		Very light brownish gray dolomite Finely porous. Fine grained. Uniform texture Slightly calcareous, due to calcite in minute cavities.
7		Brownish gray dolomite Hard crystalline somewhat porous. Drusy calcite faces along fractures.
8		Dark gray dolomite Hard with ½ druses of calcite. Crystalline glistening surface. Medium fine grained. Very slightly calcareous due to calcite in minute cavities
26		Light gray or dark. Fine grained and dense. Porous. ½" druses of calcite Fine glistening crystals. Very slightly calcareous, due to calcite in minute cavities.

Figure No 3



Vertical Scale

0 10 20 Feet

Ft	In.	
7		Light gray dolomite. Few thin shale seams. Dense hard glistening surface porous. 2 per cent disseminated galena and trace of pyrite Very slightly calcareous due to calcite in minute cavities.
5		Very porous gray dolomite. 5 per cent galena chiefly in small cavities 5 per cent pyrite intimately mixed with galena Very slightly calcareous due to calcite in minute cavities
4		Less porous gravish drab dolomite. Glistening surface Drusy calcite along seams. 1 per cent galena Trace of iron pyrites. Slightly calcareous.
6		Finely porous light gray dolomite Glistening crystalline and fine grained Traces of galena
7		Finely porous light brownish gray dolomite. Sparkling Finely crystalline.
1		Dark gray finely porous Sparkling Finely crystalline.
24		Light gray dolomite Finely porous with cavities up to 1 in diameter Surface of cavities lined with minute crystals of calcite Sparkling and crystalline Some pyrite at 373 Slightly calcareous.
23	½	Porous light gray Faint brown tint Sparkling crystalline. Fine grained Very slightly calcareous.
1	½	Finely porous dolomite Dark gray speckled with dark greenish chloritic granules. Sparkling Medium grained. Crystalline
10		Light gray somewhat porous dolomite. Dense fine grained crystalline and sparkling
11		Light gray hard dense porous dolomite. Cavities drusy Fine grained crystalline and sparkling
4		Finely porous hard dense light brownish gray dolomite Sparkling Semi-crystalline A general sugary appearance
2		Somewhat porous, light gray dolomite. Sparkling Finely crystalline.
4		Quite porous Very light brown tinted gray dolomite. Hard finely crystalline Slightly chloritic.
7		Porous light gray brown tinted dolomite Somewhat chloritic. Wavy black shale partings Sparkling Finely crystalline
12		Dull gray slightly crystalline dolomite. Shaly partings Somewhat porous
4		Dense dark gray slightly porous dolomite. Sparkling finely crystalline and somewhat shaly along parting planes.
2	½	Soft dull gray shaly dolomite Wavy parting planes. Somewhat crystalline Matrix appears earthy
	½	Shale. Earthy texture Dark green to almost olive green. A chloritic streak
5		Medium to coarsely crystalline dolomite Finely porous Chloritic. Wavy shale parting planes Dark gray Sparkling
16		Medium to coarsely crystalline arenaceous dolomite. Dark gray Sparkling Finely porous. Very slightly calcareous.
362 Ft		

At the close of the Bonneterre the St Francois mountains still rose about the ocean, as shown by the overlapping of the younger formations and their contact with the igneous rocks Shallower water conditions prevailed during the succeeding period, the Bonneterre dolomite being covered with the Davis formation consisting of shale, arenaceous dolomite, limestone and conglomerate